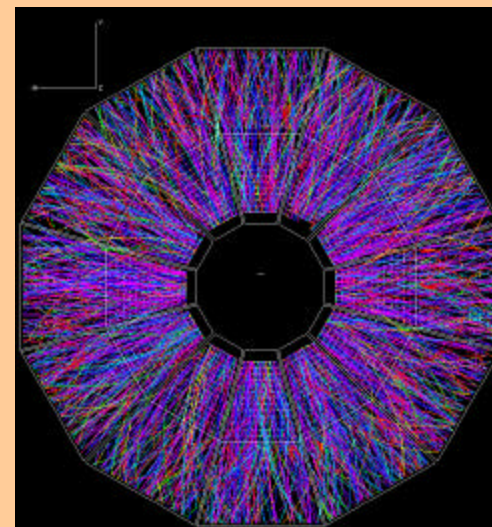
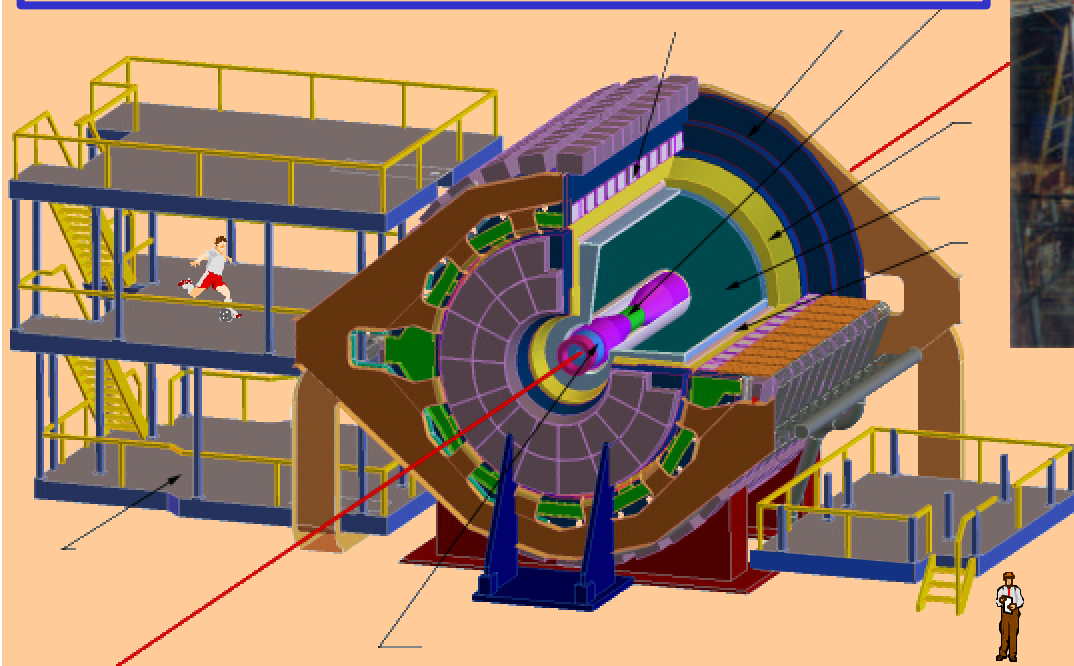


Timelines for Completing the STAR Baseline Physics Program

“Guesstrapolation” by John Harris

Acknowledgements:

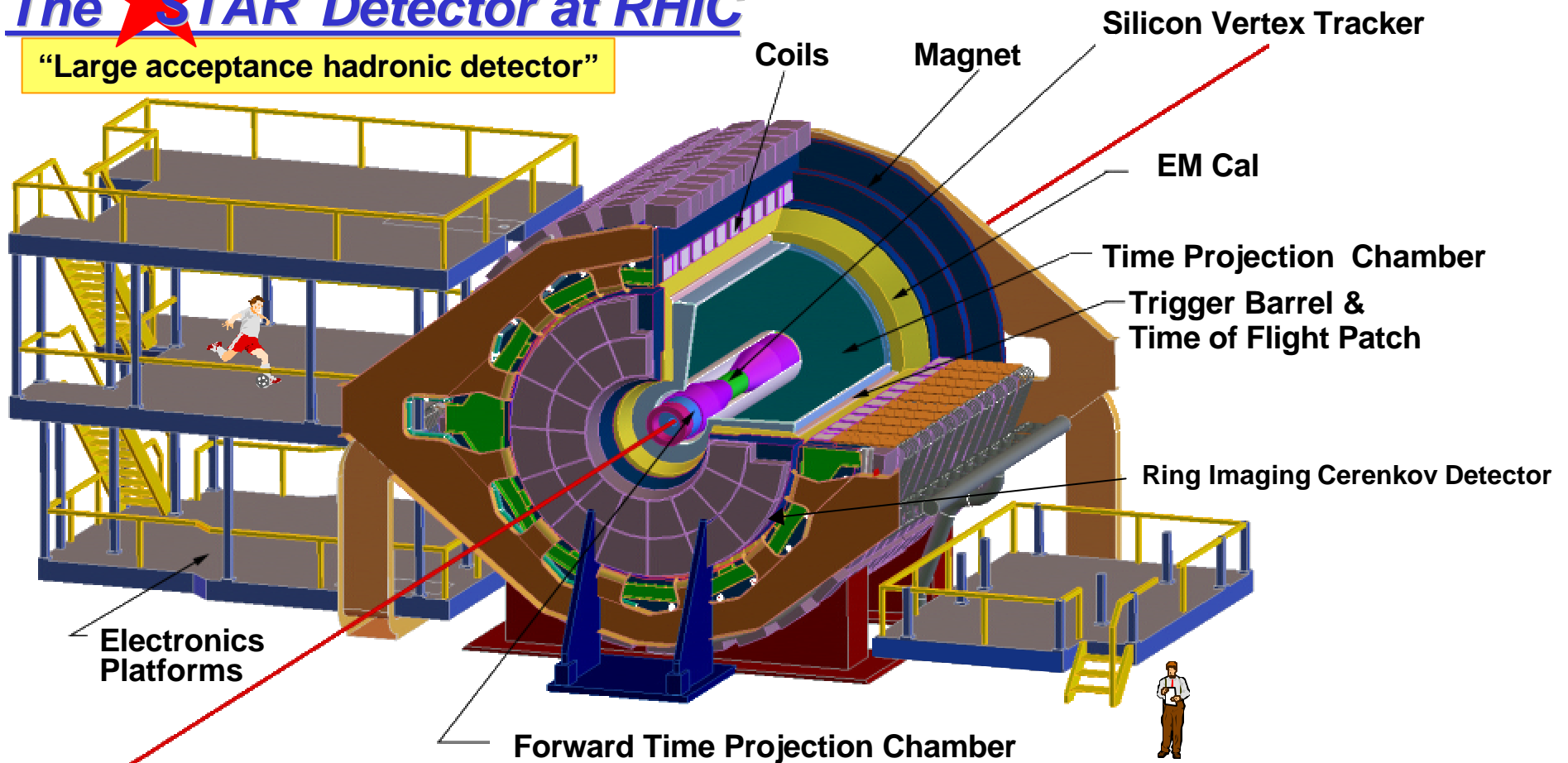
L. Bland, H. Caines, J. Cramer, G. Eppley,
T. Hallman, P. Jacobs, P. Jones, S. Klein, M. Lisa,
T. Ljubicic, J. Marx, M. Messer, R. Snellings,
T. Trainor, T. Ullrich, F. Wang



QCD at RHIC:
Workshop on Heavy Ion Physics for the Next Decade
BNL, 27 - 28 October 2000

The STAR Detector at RHIC

"Large acceptance hadronic detector"



Brazil: Sao Paolo

England: Birmingham

Germany: Frankfurt, MPI - Munich

China: IHEP - Beijing, IPP - Wuhan

France: IReS - Strasbourg, SUBATECH-Nantes

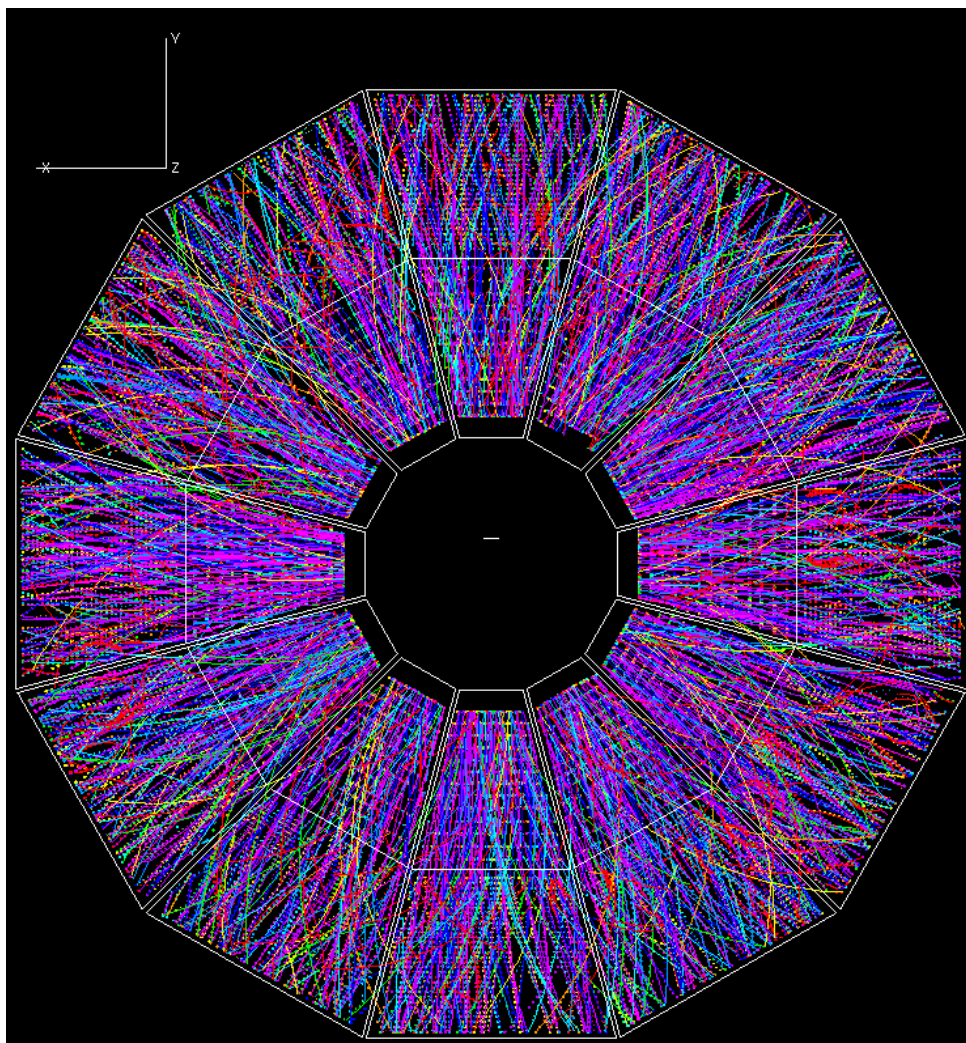
Poland: Warsaw University, Warsaw U. of Technology

Russia: MEPHI - Moscow, JINR - Dubna, IHEP - Protvino

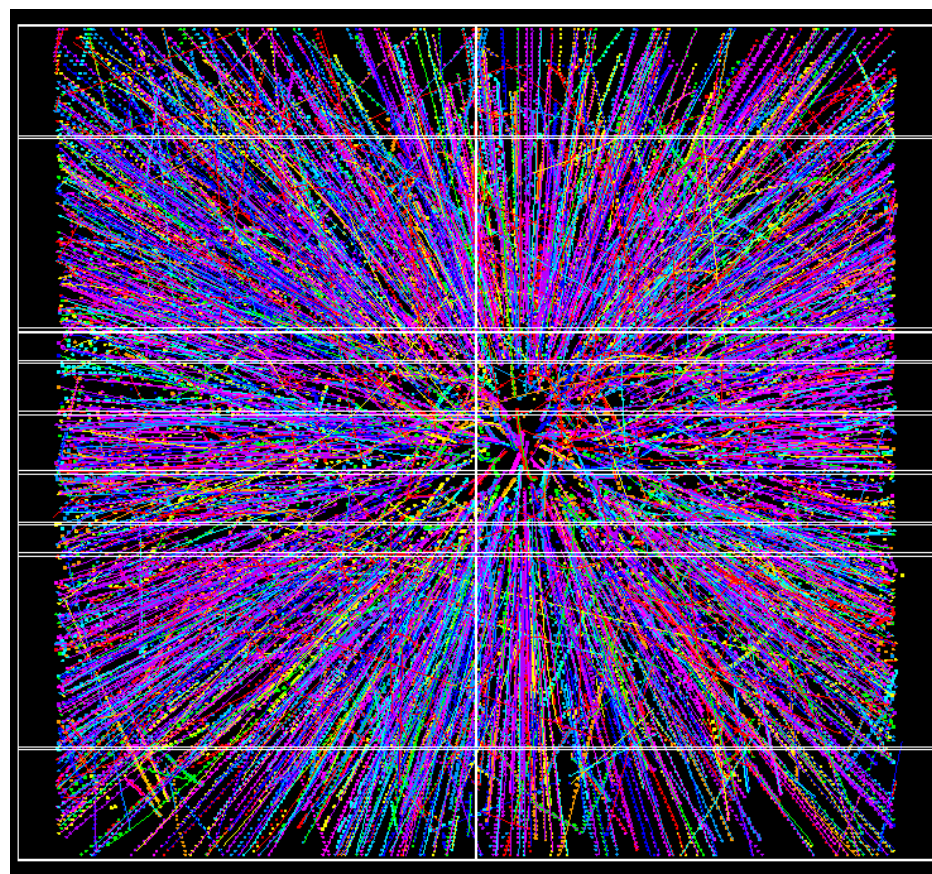
U.S.: Argonne, Berkeley, and Brookhaven National Laboratories

Arkansas, UC Berkeley, UC Davis, UCLA, Creighton, Carnegie-Mellon, Indiana, Kent State, MSU, CCNY, Ohio State, Penn State, Purdue, Rice, Texas, Texas A&M, Washington, Wayne, Yale Universities

STAR TPC Performance: Au +Au at $\sqrt{s_{NN}} = 130$ GeV



colors ~ momentum: low - high





STAR Detector Data from Summer 2000 Run

STAR Data from Summer 2000 Run:

2.0 M total trigger events taken

844 K central (~ 15% of geometrical cross section)

331 K good (5%) central for physics analysis

458 K good min bias events for physics analysis

Expected STAR Physics this Year

- | | |
|----------------------------------------------------------------------------------------------------|-------------------------------|
| • dN/dh for charged particles ($ h \in \sim 1.5$) | particle density, entropy |
| • dN/dy for p, K, \bar{p} ($-1 \in y \in 1$) | chemistry, stopping |
| • p_t spectra for identified particles
(to $p_t \sim 3$ GeV/c with RICH for p, K, \bar{p}) | temperature, radial flow |
| • High p_t spectra for charged particles | parton energy loss |
| • K/p ($-1 \in y \in 1$) | strangeness production |
| • Neutral particle decays K^0_S, π, f, K^*, L, X | |
| • $\bar{p}/p, \bar{L}/L$ ($-1 \in y \in 1$) | stopping |
| • Particle correlations (HBT) | geometry, collective flow |
| • Event-by-event correlations ($K/p, \langle p_t \rangle, SCA, \dots$) | non-statistical fluctuations |
| • Elliptic (v_2) flow | early dynamics, pressure, EOS |
| • Light nuclear and anti-nuclear yields/spectra | |

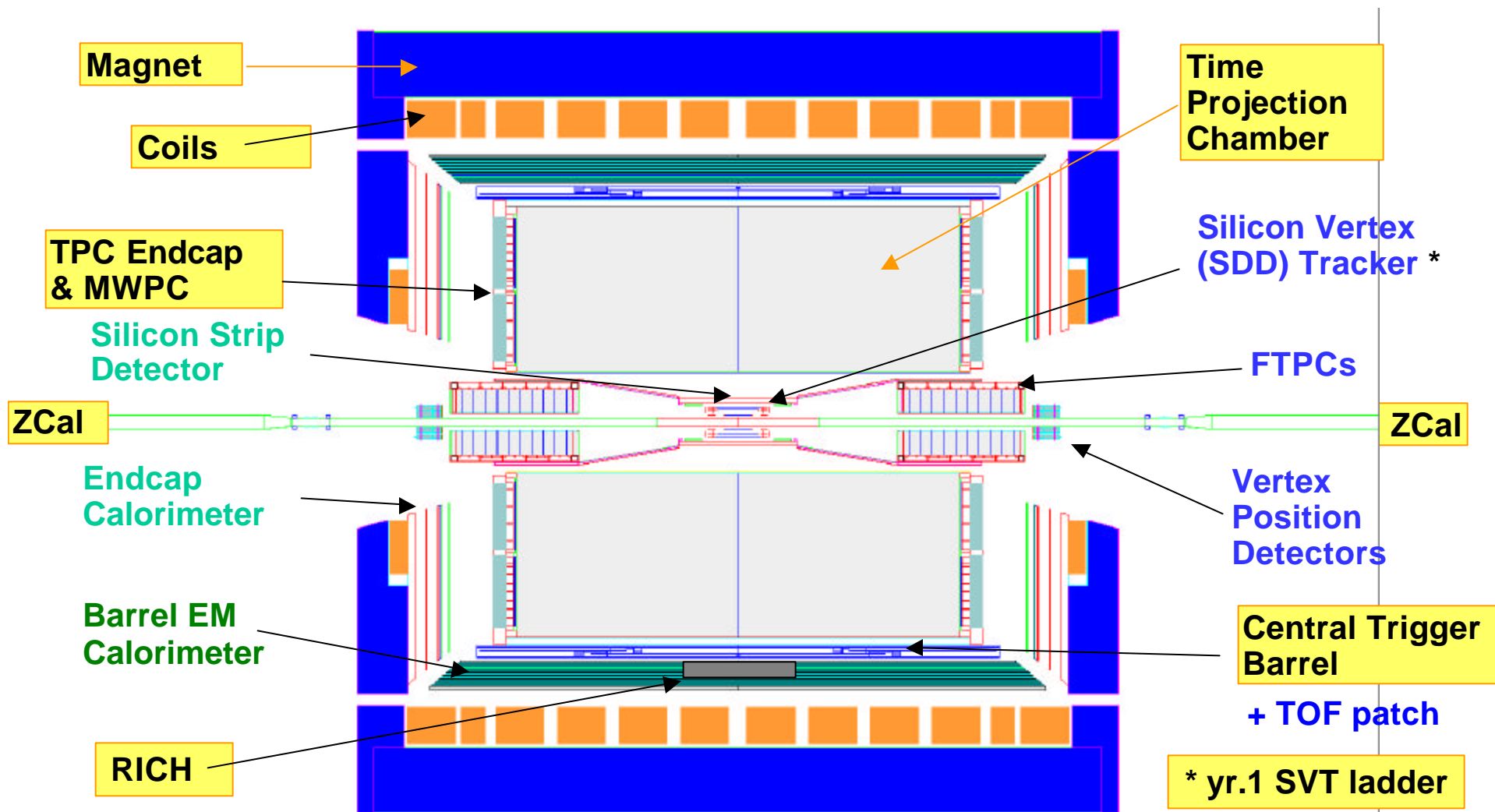
STAR Detector (year-by-year)

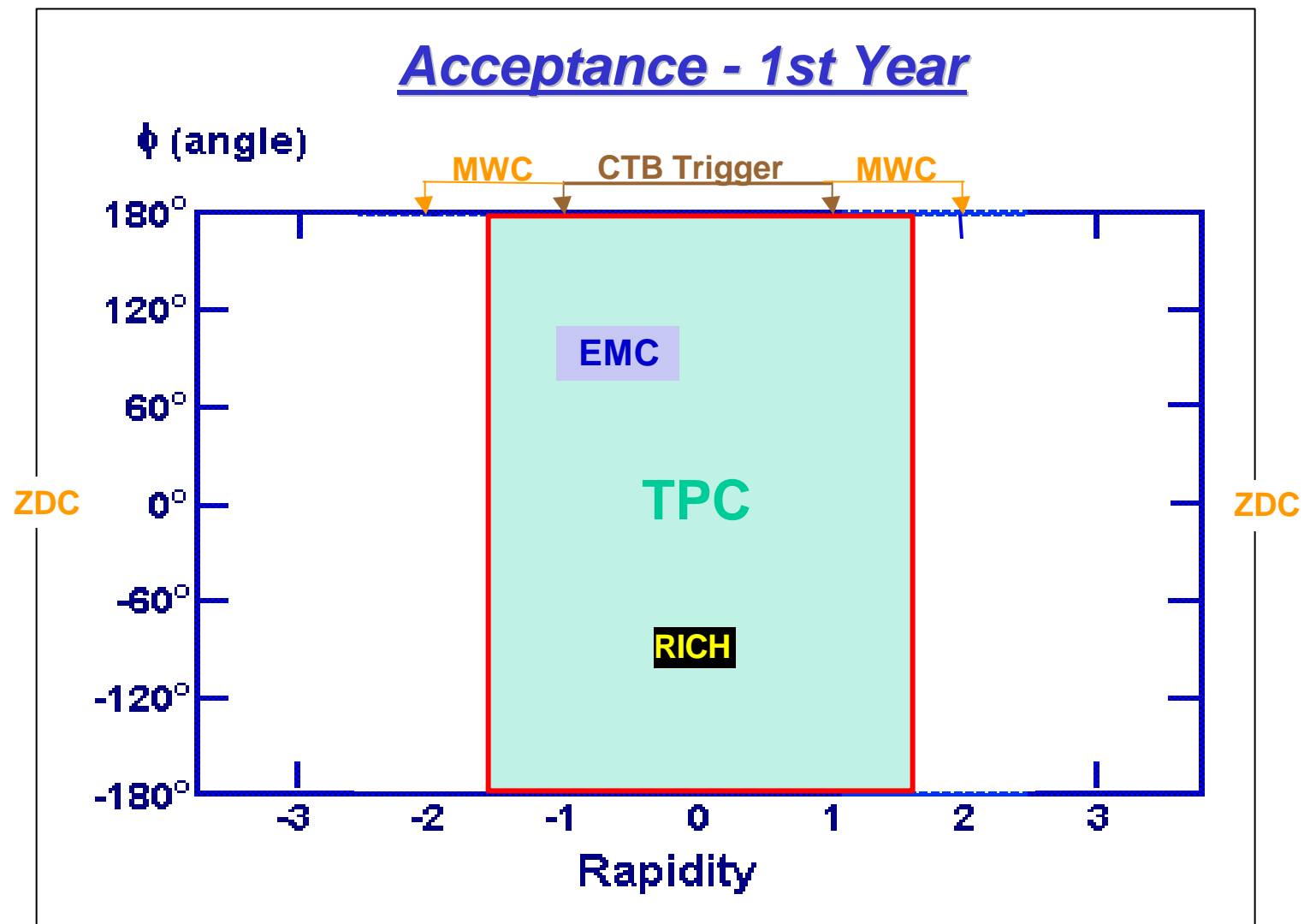
1st year detectors (now)

2nd year detectors

year-by-year implementation until 2003

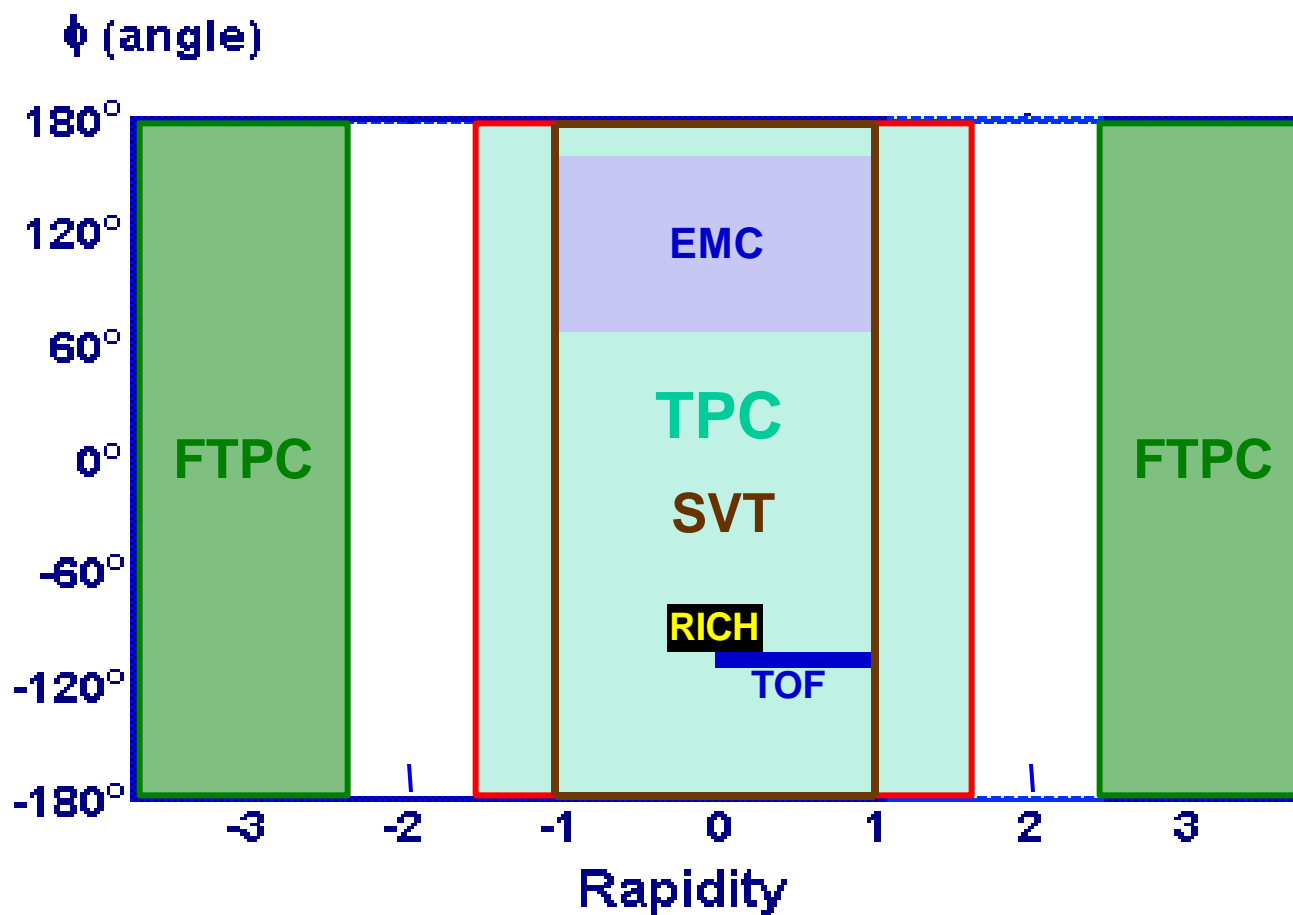
installation in 2003







Acceptance - 2nd Year





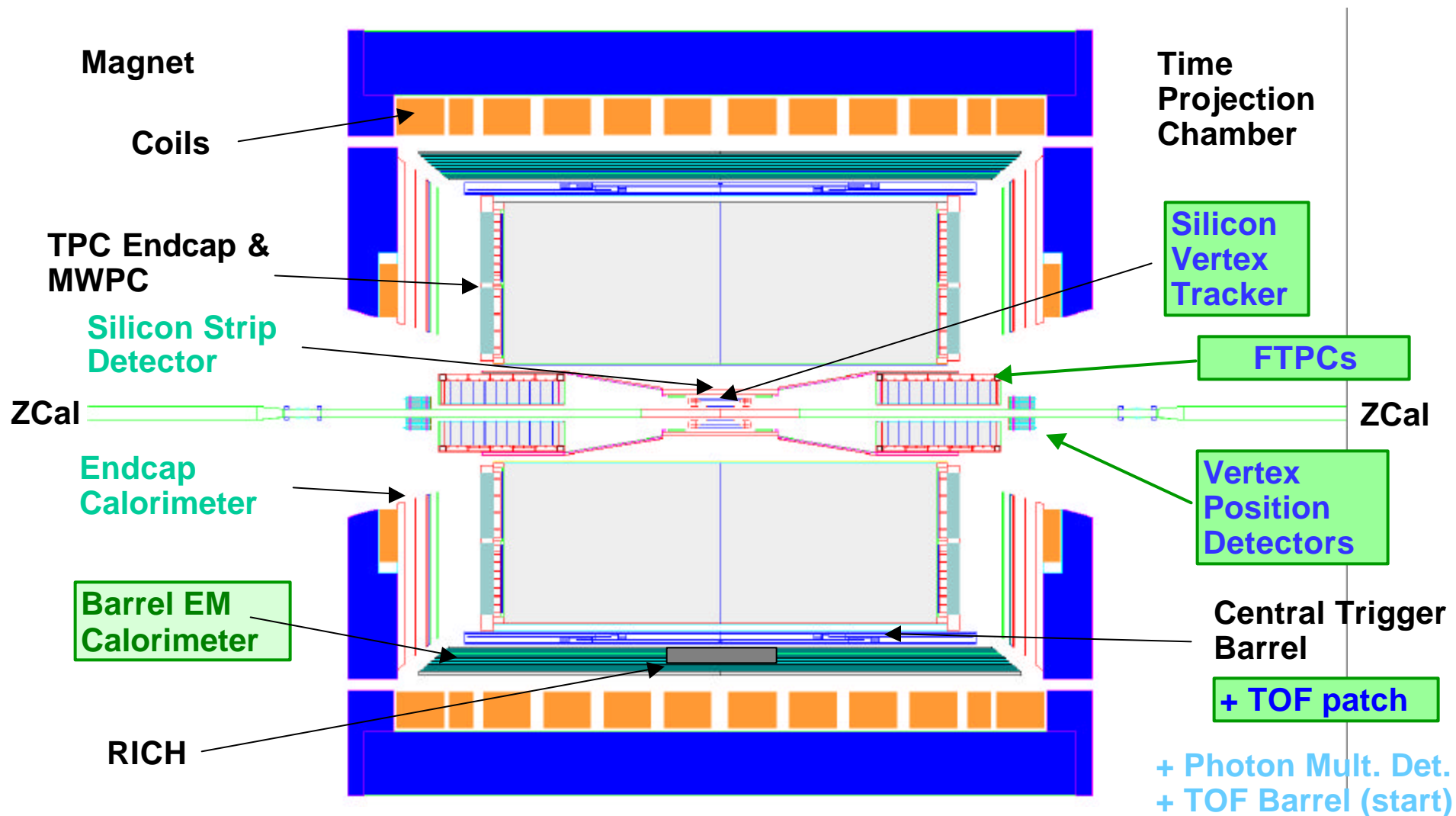
STAR Detector (year-by-year)

1st year detectors (now)

2nd year detectors

year-by-year implementation thru 2003

installation in 2002-2003





STAR Detector Additions 2001 - 2004

STAR Installation for 2001 Run

- Silicon Vertex Tracker
- Barrel Electromagnetic Calorimeter modules (total 24 of 120)
- Level 1,2, 3 Processing
- 2 Forward Time Projection Chambers
- Time-of-Flight Patch

STAR Installation for 2002 Run

- Barrel Electromagnetic Calorimeter modules (total 56 of 120)
- Data Rate Increase

STAR Installation for 2003 Run

- Barrel Electromagnetic Calorimeter modules (total 88 of 120)
- Endcap Electromagnetic Calorimeter (lower half installed)
- Photon Multiplicity Detector
- Time-of-Flight Barrel (25% of barrel)

STAR Installation for 2004 Run

- Barrel Electromagnetic Calorimeter modules (complete 120 of 120)
- Endcap Electromagnetic Calorimeter (complete)
- Time-of-Flight Barrel (75% of barrel, completed for 2005)

Overview of STAR Physics Program 2001 - 2005

RHI Physics (AA plus reference data using pp, pA)

Soft ($p_t < 2$ GeV/c) Physics (2000 - 2004)

- identified particle spectra (p, K, \bar{p} , anti-particles, strange particles, resonances)
- light anti-nuclei yields
- flow
- particle correlations
- multiply-strange baryon (X, W) spectra
- transverse energy production
- event-by-event fluctuations (inc: charge, DCC, p_t , ...; P, CP violations)
- studies of event classes

High p_t Physics (2000 - 2005)

- parton energy loss
 - charged single particles
 - identified particles (inc. p^0) to ~ 5 GeV/c
- high p_t particle correlations, photons, jets*

“electrons” (2003 \otimes)

- $f \otimes e+e^-$
- $J/\psi \otimes e+e^-$

pA physics (2003 \otimes)

- nuclear structure functions/shadowing (g-jet)
- jets, direct photons
- $J/\psi \otimes e+e^-$

Overview of STAR Physics Program 2001 - 2005

Photon/Pomeron Physics (ultra-peripheral AA)

Two-photon and photon-pomeron physics (2000 - 2003)

- states with mass < 2 GeV (2-prong final states)
- multiple vector meson production (4-prong final states)
- $J/\psi \rightarrow e^+e^-$

Higher mass states (2003 \rightarrow)

- electron decays of higher charm states
- final states containing photons
- particle identification to identify higher mass strange and charm decays
- trigger on semi-leptonic decays of charm states
- .
- .

Overview of STAR Physics Program 2001 - 2005

Spin physics (2001 ® 2005)

2001 ® A_N (with transverse spin)

2002 ® $DG(x)$ from A_{LL} from inclusive jet and dijet production

2003 ® $DG(x)$ from A_{LL} from direct photons

$DG(x)$ and $Dq(x)$ from dijet production

Higher energy - tests of parity-violating asymmetries in W production

2004 ® A_{LL} from g-jet coincidences

A_{LL} from Drell-Yan production of e^+e^-

Initial studies of parity-violating asymmetries in W production

2005 ® Measurement of parity-violating asymmetries in W production
(quark and anti-quark contribution to proton spin)



Overview of STAR Physics in 2001

- **2001 Running in STAR at RHIC**
 - Au + Au at top energy
 - Polarized p + p (single transverse and single longitudinal polarization)
 - also serves as RHI reference data
 - Possible beam/energy changes
- **Additional AA physics beyond Year 1**
 - charged hadrons at low p_t (with SVT)
 - multiply-strange baryon (X, W) yields & slopes (with SVT)
 - increased statistics for strange particles (increased efficiency with SVT)
 - p^0 identification, yields, slopes (with EMC)
 - understand high p_t triggering (with EMC)
 - transverse energy measurements (with EMC)
 - measurements of charged hadrons and strange particles at forward rapidities (with FTPCs)
 - increased coverage for event-by-event physics (with FTPCs) (flow, correlations, fluctuations, dimensional analysis)
 - reference data using p + p for soft and hard hadron physics
- **Polarized pp physics**
 - A_N (with transverse spin)
 - calibration of systematics (with longitudinal spin)



Overview of STAR Physics in 2002

- 2002 Running in STAR at RHIC
 - Beam/energy changes
 - Longitudinally polarized p + p (also use as RHI reference data)
 - Au + Au at top energy
- Additional AA physics beyond Year 2 (beam/energy scan)
 - flow
 - particle correlations
 - event-by-event fluctuations (inc: charge, DCC, p_t , ...; P, CP violations)
 - charged hadrons at low p_t
 - strange and multiply-strange baryon (X, W) yields & slopes
 - p^0 identification, yields, slopes
 - understand J/ ψ triggering (with L3)
 - transverse energy measurements
 - flow, correlations, fluctuations, dimensional analysis
- Polarized pp physics beyond Spin Year 1
 - DG(x) from A_{LL} measurements of inclusive jet and dijet production



Overview of STAR Physics in 2003

- 2003 Running in STAR at RHIC
 - Au + Au at top energy
 - Longitudinally polarized p + p (at 200 GeV and 500 GeV)
 - p + Au at top energy
- Additional AA physics beyond Year 3
 - multiply-strange baryon (X, W) yields & slopes (with SDD + SSD)
 - $K^0 K^0$ correlations, LL correlations
 - higher statistics for light anti-nuclei (triggered)
 - J/ψ @ e+e- study with Au + Au at top energy
 - f @ e+e-
 - transverse energy measurements
 - measurements relative to flow plane
 - High Pt correlations
 - fluctuations
 - studies of special event classes
 - reference data using p + p for soft and hard hadron physics
- pA physics (p + Au)
 - nuclear structure functions/shadowing (g-jet)
 - jets, direct photons
 - J/ψ @ e+e-
- Polarized pp physics beyond Spin Year 2
 - $DG(x)$ from A_{LL} measurements of direct photons
 - $DG(x)$ and $Dq(x)$ from measurements of dijet production
 - Feasibility study of e+e- Drell-Yan production
 - Higher energy - tests of signal and background rates for parity-violating asymmetries in W production



Overview of STAR Physics in 2004

- 2004 Running in STAR at RHIC
 - lighter ion at top energy
 - Longitudinally polarized p + p (at 200 GeV and 500 GeV)
 - p + Cu (?) at top energy
 - Au + Au (?) at top energy
- Additional AA physics beyond Year 4
 - multiply-strange baryon (X, W) yields & slopes (with SDD + SSD)
 - $K^0 K^0$ correlations, LL correlations
 - higher statistics for light anti-nuclei (triggered)
 - **J/ψ and f studies with lighter ion or less central Au + Au at top energy**
 - transverse energy measurements
 - measurements relative to flow plane
 - High Pt correlations
 - fluctuations
 - studies of special event classes
 - reference data using p + p for soft and hard hadron physics
- pA physics (p + Cu?)
 - nuclear structure functions/shadowing (g-jet)
 - jets, direct photons
 - J/ψ @ e+e-
- Polarized pp physics beyond Spin Year 3
 - A_{LL} measurements of g-jet coincidences
 - A_{LL} measurements for Drell-Yan production of e+e-
 - Measurement of parity-violating asymmetries in W production



STAR Data Acquisition 2001 - 2004 - Guesstrapolation

STAR Data Acquisition for 2001

- $\sqrt{s_{nn}} = 200 \text{ GeV}$ Au + Au
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ single transverse and longitudinally polarized p + p
- lower $\sqrt{s_{nn}}$ Au + Au or another system at $\sqrt{s_{nn}} = 200 \text{ GeV}$

STAR Data Acquisition for 2002

- lower $\sqrt{s_{nn}}$ Au + Au and/or other systems at $\sqrt{s_{nn}} = 200 \text{ GeV}$
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ longitudinally polarized p + p
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ Au + Au (some)

STAR Data Acquisition for 2003

- $\sqrt{s_{nn}} = 200 \text{ GeV}$ Au + Au (mostly)
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ longitudinally polarized p + p at $\sqrt{s} = 200$ and 500 GeV
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ p + Au

STAR Data Acquisition for 2004

- $\sqrt{s_{nn}} = 200 \text{ GeV}$ lighter ion or Au + Au (mostly)
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ longitudinally polarized p + p at $\sqrt{s} = 200$ and 500 GeV
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ p + Cu (?)
- possibly lower $\sqrt{s_{nn}}$ Au + Au or another system at $\sqrt{s_{nn}} = 200 \text{ GeV}$

STAR Data Acquisition for 2005

- $\sqrt{s_{nn}} = 200 \text{ GeV}$ Au + Au or lighter system (mostly)
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ longitudinally polarized p + p at $\sqrt{s} = 200$ and 500 GeV
- $\sqrt{s_{nn}} = 200 \text{ GeV}$ p + A(?)

Summary - Timelines for Completing STAR Baseline Physics

Successful data-taking in 2000

Adding detectors over the next three years to complete original concept of STAR

SVT, FTPC, TOF-patch, higher level triggers, DAQ rate, SSD, PMD, EMC, EEMC, TOF

RHI Physics (AA plus reference data using pp)

Soft ($p_t < 2$ GeV/c) Physics (2000 - 2004)

High p_t Physics (2000 - 2005)

“electrons” (2003 \otimes)

- $f \otimes e+e-$, $J/\psi \otimes e+e-$

pA physics (2003 \otimes)

- nuclear structure functions/shadowing (g -jet)
- jets, direct photons, $J/\psi \otimes e+e-$

Photon/Pomeron Physics (ultra-peripheral AA)

Two-photon and photon-pomeron physics (2000 - 2003)

- states with mass < 2 GeV

Higher mass states (2003 \otimes)

- electron decays of higher charm states
- final states containing photons
- higher mass strange decays

Spin physics (2001 \otimes 2005)

2001 \otimes A_N (with transverse spin)

2002 \otimes $DG(x)$ from A_{LL} from inclusive jet and dijet production

2003 \otimes $DG(x)$ from A_{LL} from direct photons $DG(x)$ and $Dq(x)$ from dijet production

Higher energy - tests of parity-violating asymmetries in W production

2004 \otimes A_{LL} from g -jet coincidences A_{LL} from Drell-Yan production of $e+e-$

2005 \otimes Measurement of parity-violating asymmetries in W production
(quark and anti-quark contribution to proton spin)